
Ferroelectricity Newsletter

A quarterly update on what's happening in the field of ferroelectricity

Volume 7, Number 2

Spring 1999

WORLDWIDE FERROELECTRICITY RESEARCH: INTERDISCIPLINARY IN NATURE

Leafing through conference announcements, meeting reports, or symposium proceedings, one cannot help but be struck by the interlacing and overlapping quality of research in the field of ferroelectricity.

One case in point is the article by **Orlando Auciello, James F. Scott, and Ramamoorthy Ramesh** called “**The Physics of Ferroelectric Memories**” published in the July 1998 issue of *Physics Today*. To find out more about it, turn to page 16.

On pages 15 and 16 you will find information on the **latest publications of the Material Research Society (MRS)**, featuring low-dielectric constant materials and topics such as stresses and mechanical properties of thin films. In addition, you might be interested in a free copy of the 1999 MRS Publications Catalog Supplement (see order information on page 16).

From the National Physical Laboratory in Teddington, Middlesex, UK, comes an invitation to measurement laboratories to cooperate in evaluating methods for determining performance related properties of electroceramics. Researchers interested in getting involved in the so-called “**Versailles Project**,” will find details on page 14.

In the section Upcoming Meetings we feature the MRS 1999 Fall Meeting in Boston and two conferences that takes place in Russia: the **15th Russian Conference on Physics and Ferroelectrics** and **Piezotechnique 99**, both held at the same time and place from 14 - 18 September 1999 in Azov near Rostov-on-Don.

As has become the custom in the *Ferroelectricity Newsletter*, the major part of each issue is taken up with listing the titles and authors of presentations at a variety of conferences. This issue is no exception. You will find the oral and poster papers given at the **11th International Symposium on Integrated Ferroelectrics**, held from 7 - 10 March 1999 in Colorado Springs, Colorado, USA. In the next issue we plan to bring you the list of presentations delivered at the **Sixth Japanese – CIS/Baltic Symposium on Ferroelectricity** that took place in Noda, Japan, from 22 - 25 March 1998. These proceedings were published in Volume 218, Numbers 1-4 (1998) of *Ferroelectrics*.

Rudolf Panholzer
Editor-in-Chief

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ISIF'99 PAPERS

The following is a list of the titles and authors of the presentations given at the 11th International Symposium on Integrated Ferroelectrics (ISIF'99) held from 7–10 March 1999 in Colorado Springs, Colorado, USA.

PLENARY SESSION I

Development Challenges of Gigabit Scale 1T-1C DRAMs
B. Melnick

Piezoelectric and Pyroelectric Thin Films for Sensors and Actuators
N. Setter

PLENARY SESSION II

High-Density FeRAMs
C. Paz de Araujo

Technology Perspective for 1T/1C FeRAMs
K. Kim

PLENARY SESSION III

Studies of Ferroelectric Thin Film and Film-Based Device Processes Via *in situ* Analytical Techniques
O. Auciello

CIRCUITS AND DEVICES

Integration Technology for Ferroelectric Memory
H. Hada and T. Kunio

A 3v 1T/1C 256Kbit FeRAM Using SBT

D.A. Kamp, M.V. Cordoba, D.E. Hodges, G.F. Derbenwick, H.W. Kye, W.S. Kang, and N.S. Kang

A 42.5mm² Nonvolatile Ferroelectric Memory Utilizing Advanced Architecture for Enhanced Reliability

W. Kraus, L. Lehman, D. Wilson, T. Yamazaki, C. Ohno, E. Nagai, H. Yamazaki, and H.

Suzuki

Retention Performance of SBTN FeRAM Memory
T. Davenport, and S. Mitra

Integration of Ferroelectric Random Access Memories with a New Cell Structure Using a Novel Processing Technology

D.C. Kim, H.J. Nam, H.M. Lee, S.M. Cho, W. Jo, J.U. Bu, H.B. Kang, and K.Y. Oh

Advanced LSI Embedded with FeRAM for Contactless IC Cards and Its Manufacturing Technology
Y. Shimada, K. Arita, E. Fujii, T. Nasu, Y. Nagano, A. Noma, Y. Izutusu, K. Nakao, K. Tanaka, T. Yamada, Y. Uemoto, K. Asari, G. Nakane, A. Inoue, T. Sumi, S. Chaya, T. Nakakuma, H. Hirano, Y. Judai, Y. Sasi, and T. Otsuki

An RFID Tag with an Embedded 1K FeRAM Using SBT
G.B. Coombe, T.A. Meester, M.V. Cordoba, D.A. Kamp, G.F. Derbenwick, G. Nakane, A. Inoue, T. Sumi, and T. Otsuki

Evolution of the Integration of FeRAM in RFID Applications
D. White, and S. Mitra

A Demonstration of Low Voltage Performance, From Scaled PLZT Films, on a Fully Integrated 64K FeRAM
B. Estep, J. MacWilliams-Brooks, and S. Mitra

A Method of Characterizing Sense Amplifier Imbalance Issues on a 2T/

2C FeRAM Memory
S. Mitra

DEVICE INTEGRATION ISSUES

The Challenges of Integrating BST Capacitors in Embedded DRAMs
A.R. Sitaram, and B.E. White

Integration of Pt/PZT/Pt Ferroelectric Capacitors into .05μm CMOS Process for Embedded FeRAM
D.J. Wouters, G. Norga, L. Haspeslagh, L. Deferm, and H. Maes

Remanence Polarity Effects on Hydrogen Damage of Ferroelectric Thin Film Capacitors
S. Traynor, S. Sun, and T.D. Hadnagy

Effects of Ferroelectric Processing on CMOS in FeRAM
S.W. Lee, E.Y. Kang, S.K. Hong, J. Lee, and N.S. Kang

Fabrication of Sol-Gel Derived Pb(Zr,Ti)O₃ Capacitors with Etch Stopping Layers
H.M. Lee, D.C. Kim, H.J. Nam, S.M. Cho, W. Jo, and J.U. Bu

Direct Wafer Bonding and Layer Transfer – A New Approach for Integration of Ferroelectric Oxides into Silicon Technology
M. Alexe, St. Senze, A. Pignolet, D. Hesse, and U. Gøsele

Influence of Dry Etching Using Ar and Cl on Structural and Electrical Properties of Crystalline and Non-Crystalline SrBi₂Ta₂O₉ Thin Films

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W. Hartner, V. Weinrich, G. Schindler, N. Nagel, C. Dehm, C. Mazur, H. Schroeder, and R. Waser

Plasma Etching of Ir/PZT FeRAM Device Structures

F.G. Celii, T.S. Moise, S.R. Summerfelt, L. Archer, R.A. Beavers, D. Vestyk, S. Johnston, S. Bilodeau, M. Russell, and P.c. van Buskirk

Etching Pt Electrodes in a Decoupled Plasma Source Chamber

J. Hwang, S. Mak, C. Ying, K-L. Chiang, and J. Jin

Etching Mechanisms During Platinum Thin Film Patterning with a Microwave Ion Gun

K. Baborowski, P. Murali, and N. Lederman

FIELD EFFECT DEVICES / THEORY

Advanced Ferroelectric Memory FET Devices

T. Nakamura, Y. Fujimori, and H. Takasu

Fabrication and Characterization of MFSFET Arrays Using Al/BaMgF₄/Si(111) Structures

K. Aizawa, and H. Ishiwara

Ferroelectric-Gate Transistor as a Capacitor-less DRAM Cell

J-P. Han, and T.P. Ma

Characterization of Y1-Based Ferroelectric Gate MOS Capacitors Formed by MOD Technique for Nonvolatile Memory Applications

K. Arita, T. Otsuki, Z. Chen, M. Lim, J.W. Bacon, and C.A.

Paz de Araujo

Fabrication and Characterization of MFISFET Using CMOS Process for Single Transistor Memory Application

I. Chung, C.J. Kim, T-Y. Kim, Y. Park, and C.W. Chung

Crystalline Oxides on Silicon – Alternative Dielectrics for a Ferro-Gated Transistor Technology

R.A. McKee, F.J. Walker, and M.F. Chisholm

Epitaxial BaTiO₃ Films on Silicon for MFSFET Applications

J. Hallmark, J. Yu, R. Droopad, J. Ramdani, J. Curless, C. Overgaard, J. Finder, D. Marshall, J. Wang, and B. Ooms

Ferroelectric Self-Field Effect: Implications for Size Effect and Memory Device

Y. Watanabe

FUNCTIONALLY GRADED FERROELECTRICS

Graded Ferroelectrics: A New Class of Steady-State Thermal/Electrical/Mechanical Energy Interchange Devices

N. Schubring, J. Mantese, A. Micheli, A. Catalan, M. Mohammed, R. Naik, and G. Auner

Graded Ferroelectric Thin Films Grown by Molecular Beam Epitaxy

X. Pan, W. Tian, and J. Jiang, J. Hacni, C. Theis, J. Lettieri, and D. Schlom

Giant Effective Pyroelectric Coefficients from Functionally Graded

Ba_xSr_{1-x}TiO₃ (x = 0 – 0.3) Ferroelectric Devices

G. Auner, R. Naik, C. Huang, F. Jin, J. Mantese, N. Schubring, A. Micheli, and A. Catalan

Functionally Graded High-K (Ba_{1-x}Sr_x)TiO₃ Thin Films for Capacitor Structures with Low Temperature Coefficient

R. Slowak, S. Hoffmann, Ralf Liedtke, and Rainer Waser

Graded PZT Thin Film Capacitors with Stoichiometric Variation by MOD Technique

Z. Chen, K. Arita, M. Lim, and C. Paz de Araujo

Theory of Ferroelectric Heterostructures

A. L. Roytburd – University of Maryland

HIGH FREQUENCY DEVICES

Correlation Between Material Properties of Ferroelectric Thin Films and Design Parameters for Microwave Devices Applications: Modeling Examples and Experimental Verification

F.A. Miranda, F.W. Van Keuls, C.H. Mueller, R.R. Romanofsky, and G. Subramanyam

Dielectric Properties of SrTiO₃ Thin Films for Tunable Microwave Devices

X.X. Xi, H-C. Li, W. Si, I.A. Akimov, J.R. Fox, A.M. Clark, and A.A. Sirenko

Performance of Ferroelectric Based Tunable Devices as a Function of Electrode Material and Geometry

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T.V. Rivkin, C.M. Carlson, P.A. Parilla, and D.S. Ginley

The Role of Strain and Interfaces in Ferroelectrics for Tunable Microwave Devices

H-M. Christen, L.A. Knauss, K.S. Harshavardhan, and S.D. Silliman

Dielectric Properties of (Ba,Sr)TiO₃ Thin Films for tunable Microwave Applications

W. Chang, J.S. Horwitz, W-J. Kim, J.M. Pond, S.W. Kirchoefer, S.B. Qadri, and D.B. Chrisey

Evidence of a Ferroelectric Phase Transition in Fiber-Textured (Ba_xSr_{1-x})Ti_{1+y}O_{3+z} Thin Films on Pt/SiO₂/Si

S.K. Streiffer, S.E. Lash, C.B. Parker, A.I. Kingon, C.E. Bouldin, B. Ravel, D.L. Kaiser, A. Sirenko, and X.X. Xi

Microwave Phase Shifters Based on Ferroelectric Films

A.B. Kozyrev, A.V. Ivanov, T.B. Samoilova, O.I. Soldatenkov, L.C. Sengupta, L. Chiu, X. Zhang, Y. Zhu, S. Stowell, S.T.V. Rivkin, C.M. Carlson, P.A. Parrila, and D.S. Ginley

MATERIALS AND PROCESSES FOR DRAMS

Depletion Widths in BST DRAMs I: Voltage Dependence

S. K. Dey

Depletion Widths in BST DRAMs II: Zero-Voltage Value ($d = 5 \pm 2$ nm)

J. F. Scott

Effect of the Catalytic Nature of the Platinum Group Metals on Electrode and Barrier Structures for (Ba,Sr)TiO₃ Thin Film Capacitors
M. Raymond, B White, S. Madhukar, M. Kottke, T. Rummel, B. Melnick, and C. Tracy

The Temperature Dependence of the Dielectric Properties of (Ba,Sr)TiO₃ Thin Films

T. M. Shaw, J. D. Baniecki, R. B. Laibowitz, D. E. Kotecki, H. Shen, and J. Lian

Leakage Current and Resistance Degradation Behavior of Doped Ba_{0.7}Sr_{0.3}TiO₃ Thin Films for DRAM Applications

S. Hoffman, M. Grossman, and R. Waser

Effect of N₂O on RF-Magnetron Sputtered SrTiO₃ Films for ULSI DRAM Application

J. Han, V. Balu, J. Lee, R. Mohammedali, S. Gopalan, C. Wong, and J. C. Lee

Low Temperature MOCVD BST for High Density DRAM Capacitors

J. Joo, J. Park, Y. Kim, K. Lee, J. Lee, J. Roh, J. Kim –

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BSTO Thin Film for a DRAM Capacitor: Materials Requirements and Issues

J. Lian, H. Shene, M. Gutsche, G. Kunkel, Y.J. Park, Y. Wang, C. Lin, D.E. Kotecki, R. Laibowitz, J.D. Baniecki, K.L. Saenger, T.M. Shaw, S. Athaval,

C. Cabral, P. Duncome, and R. Wise

A TiSiN-based Oxidation-proof Diffusion Barrier for Integrated BST Capacitors

H. Horii, B. Taek Lee, S.H. Ju, C.Y. Yoo, H.J. Lim, C.S. Kang, H.B. Park, W.D. Kim, and S.I. Lee

Microstructure Evolution and Properties of Sub-500Å Ba_xSr_{1-x}TiO₃ Thin Films by MOCVD

P. Mahji, Y.W. Shin, D. Tang, S.K. Dey, J. Zhao, C. Dornfest, and L. Luo

Use of Deuterium Tracer Anneals to Investigate Hydrogen-Induced Degradation of Pt/Ba_{1-x}Sr_xTiO₃/Pt Capacitors

S.R. Gilbert, L. Colombo, T.S. Moise, P. Chen, S.R., Summerfelt, and Y. Okuno

Sputter Deposited Ba_{1-x}Sr_xTiO₃ Thin Films for Capacitor Applications

L.A. Wills, and J. Amano

Thermal Stability of Conducting Si/TaN/Ir Electrode for Ferroelectric Memory Device Applications

F. Zhang, J-S. Maa, T. Li, Y. Ma, and S.t. Hsu

Effects of the Microstructure of Platinum Electrode on the Oxidation Behavior of TiN Diffusion Barrier Layer

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Preparation and Evaluation of $\text{SrBi}_2\text{Ta}_2\text{O}_9$ Thin Films Prepared by the Sol-Gel Method

I. Koiwa

Sub-100 nm SBT Thin Films for Low Voltage and High Density FeRAM Applications

V. Joshi, S. Narayan, L.D. McMillan, and C. Paz de Araujo

Effects of Ca and Sr Dopants in PLZT Thin Films for Low Voltage Operation

S-H. Kim, D-J. Kim, J-P. Maria, A.I. Kingon, T.D. Hadnagy, and S. Sun

Ferroelectric Properties of $\text{Pb}_{0.6}\text{Sr}_{0.4}\text{TiO}_3$ Thin Films on Perovskite Buffer Layers

C-S. Hou, G-C. Chang, C-C. Chou, and H-F. Cheng

Nearby-Electrode Injection in Ferroelectric Thin Film Capacitors: Manifestation in Size Effect and Fatigue

A.K. Tagantsev, and I.A. Stolichnov

Dielectric and Electric Properties of Sol-Gel Derived PZT and PNZT Thin Films

K. Hong, Y.S. Yu, and B.H. Kim

Low Temperature Synthesis of Ferroelectric $\text{Sr}_2\text{Nb}_2\text{O}_7$ Thin Films by Rapid Thermal Annealing

M. Shoyama, A. Tsuzuki, K. Kato, and N. Murayama

Thickness Effect in PZT and SBT Ferroelectric Thin Film

J.S. Zhu, X.M. Lu, Z.G. Zhang,

H.X. Qin, X.B. Chen, and Y.N. Wang

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Barrier Layers for Integration of Ferroelectric Capacitors on Si

S. Aggarwal

Texture Control of $\text{Pb}(\text{Zr,Ti})\text{O}_3$ Thin Films

K. Torii, Y. Matsui, and Y. Fujisaki.

Hydrogen-Induced Imprint Mechanism of Pt/PZT/Pt Capacitor by Low-Temperature Hydrogen Treatment

H. Kanaya, T. Iwamoto, Y. Takahagi, I. Kunishima, and S. Tanaka

Analysis of Degradation of Pt/ $\text{SrBi}_2(\text{Ta/Nb})_2\text{O}_9$ /Pt Capacitors During Annealing in Reductive Atmosphere

A. Tofuku, T. Yoshie, T. Osaka, I. Koiwa, H. Kato, Y. Sawada, and A. Hashimoto

Effect of Top Electrode Deposition Conditions on the Reliability of Pt/PZT/Pt Ferroelectric Capacitors

D.J. Wouters, A.T. Bartic, G. Nords, and H.E. Maes

Evaluation of PZT Capacitors with Pt/SRO and Pt/IrOx Electrodes for FeRAM

J.S. Cross, M. Fujiki, M. Tsukada, T. Tamura, K. Matsuura, H. Ashida, and S. Otani.

Electrical Properties of PZT Thin

Film Capacitors with SrRuO_3 Electrode

H. Kanai, Y. Yamashita, and H. Yamakawa

Fabrication of Multilayer Ferroelectric Films

D.A. Neumayer, P.R. Duncombe, R. Laibowitz, T. Shaw, C. Black, L. Berndt, and A. Grill

Low Temperature Crystallization of $\text{Pb}(\text{Zr,Ti})\text{O}_3$ Thin Films

T. Fujimori, T. Nakamura, and H. Takasu

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Process Engineering Issues of CSD-Based Thin Film Multi-Level Ceramic Capacitors

M. Watt

The Evolution and Status of Misted Chemical Thin Film Deposition

L.D. McMillan

A Study on Low-Temperature Crystallization of $\text{SrBi}_2\text{Ta}_2\text{O}_9$ Thin Films Prepared by Sol-Gel Method Using Steam Curing Process

Y. Sawada, H. Kobari, Y. Sato, A. Hashimoto, I. Koiwa, H. Kobayashi, and T. Osaka

Thickness Effects in Chemical Solution Derived PLZT Thin Films on Fatigue and Imprint

S-H. Kim, D-J. Kim, J-P. Maria, and A.I. Kingon

Review of SBT Thin Film Capacitor Processing

C. Dehm, C. Mazur, W. Hartner,

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and G. Schindler

Comparison of CSD and Sputtered PZT with Iridium Electrodes

G.R. Fox, S. Sun, B. Eastep, and T.D. Hadnagy

Processing of Multilayer PZT Coatings for Device Purposes

T. Olding, B. Leclerc, and M. Sayer

Chemical Solution Deposition of BaTiO₃ Thin Films

D-Q. Li, and Q.X. Jia

What is the Outlook for PZT Films for Low Voltage NVM Operation?

A.I. Kingon, S-H. Kim, D.J. Kim, J.G. Hong, J-P. Maria, and S.K. Streiffer

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Chemical Vapor Deposition of SrBi₂Ta₂O₉ Thin Films for Non-volatile Memory Applications

K. Hironaka and C. Isobe

Fatigue Free Ferroelectric Pb₅Ge₃O₁₁ Thin Films Prepared by Metalorganic Chemical Vapor Deposition

T. Li, F. Zhang and S.T. Hsu

Novel Precursors for the MOCVD of Ferroelectric Thin Films

T.J. Leedham, A.C. Jones, H.O. Davies, P. O'Brien, P.J. Wright, M.J. Crosbie, and D.J. Williams

Low-Voltage Ir/PZT/Ir Integrated Capacitors Formed Using Thin-Film MOCVD PZT

T.S. Moise, S.R. Summerfelt, F.G. Celii, L. Archer, P. Chen, S. Gilbert, M. Anthony,

P.C. Van Buskirk, S. Bilodeau, S. Johnston, M. Russel, and D. Vestyk

Rotating Disk Reactor – Low Pressure Chemical Vapor Deposition (CVD) System Designed for Complex Oxide Film Production

G.S. Tompa, L.G. Provost, C. Zhang, J. Mantesse, F.P. Gnadinger, G. Huebner, and D. Bingham

New Low Temperature Preparation of Ferroelectric Bi₄Ti₃O₁₂ Thin Films by MOCVD Method

T. Kuma

Metal-Organic Chemical Vapor Deposition and Characterization of Strontium Bismuth Tantalate (SBT) Using a Novel Liquid Delivery System

S. Narayan, L. McMillan, C.A. Paz de Araujo, K. Uchiyama, M. Schumacker, and H. Juergensen

Direct Deposition of SrBi₂Ta₂O₉ Film on IrO₂ Electrode Using Liquid Source CVD Method

T. Eshita, H. Yamawaki, S. Miyagaki, and Y. Arimoto

Effects of Growth Conditions and Rf Plasma on Crystalline and Electrical Properties of SrBi₂Ta₂O₉ Thin Films Grown by Liquid Delivery MOCVD Using a Double Alcoholate

T. Jimbo, H. Sano, H. Ishiwaru, Y. Takahashi, E. Tokumitsu, and H. Funakubo

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Epitaxial Growth of Aurivillius Phases by MBE and PLD

D.G. Schlom, C.D. Theis, J. Lettieri, Y. Jia, G.W. Brown, M.E. Hawley, J.C. Jiang, X.Q. Pan, H. Li, R. Ramesh, O. Auciello, J. Im, A.R. Krauss, R. Uecker, and P. Reiche

Effect of Characteristics of SrRuO₃ Buffer Layer on the Ferroelectric Properties of (Pb_{1-x}La_x)(Zr_{1-y}Ti_y)O₃ Thin Films

H-F. Cheng, K-S. Liu, and I-N. Lin

Process Stability of Ferroelectric PLZT Thin Film Sputtering for FRAM Production

K. Suu, N. Tani, F. Chu, G. Hickert, D. Hadnagy, and T. Davenport

Epitaxial Bismuth-Layer-Structured Perovskite Ferroelectric Thin Films Grown by Pulsed Laser Deposition

A. Pignolet, K.M. Satyalakshmi, M. Alexe, N.D. Zakharov, C. Harnagea, S. Senze, D. Hesse, and U. Gösele

Growth of (111)-Oriented PZT on RuO₂ (100) / Platinum (111) Electrodes by *in situ* Sputtering

T. Maeder, P. Muralt, L. Sagalawicz, and S. Hiboux

SBTN Thin Film Capacitors Prepared by Rf-Magnetron Sputtering

S. Sun, G.R. Fox, and T.D. Hadnagy

Interfacial Structure and Ferroelectric Properties of PZT/SrRuO₃ Heterostructures on Miscut (001)SrTiO₃

K. Wasa, Y. Haneda, H. Adachi, I. Kanno, K. Setsune, D.G. Schlom, S. Trolier-McKinstry, Q. Gan, and C.B. Eom

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The Ferroelectric Properties of PZT40/60 Thin Films Prepared Using ULVAC ZX-1000 Rf Sputtering System

F. Chu, G. Hickert, T.D. Hadnagy, and K-K. Suu

NOVEL CHARACTERIZATION: I

SLIMM: A Technique for Determination of the Spatial Distribution of the Spontaneous Polarization in Ferroelectric Thin Films

S.B. Lang

Determination of the Thickness Spatial Polarization Distribution in Sputtered PZT Thin Films Using the Laser Intensity Modulation Method

T. Sandner, G. Suchanek, B. Köhler, and G. Gerlach

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V. Gopalan, A. Itagi, S. Gerstl, P. Swart, and E.E. Mitchell

Studies of Hydrogen-Induced Degradation Processes in $\text{Pb}(\text{Zr}_x\text{Ti}_{1-x})\text{O}_3$ (PZT) Ferroelectric Film-Based Capacitors Using Massing Spectroscopy of Recoiled Ions, Raman Spectroscopy Analysis and Electrical Characterization

A.R. Krauss, J. Im, O. Auciello, A. Dhote, S. Aggarwal, and R. Ramesh

The Effects of Oxygen Deficiency on Vacancy Related Defects in $(\text{Pb},\text{La})(\text{Zr},\text{Ti})\text{O}_3$ Capacitors Studied by Positron Annihilation Spectroscopy

T. Freissnegg, S. Aggarwal, R. Ramesh, B. Nielsen, D.J. Keeble, and E.H. Poindexter

Probing Statics and Dynamics of Domain Switching in Epitaxial PZT Films Using X-Ray Scattering

C. Thompson, A. Munkolm, K. Ghosh, O. Auciello, and G. Bai

Studies of $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ Thin Films Growth Processes Using *in situ* Time-of-Flight Mass Spectroscopy of Recoiled Ions

A.M. Dhote, A.R. Krauss, O. Auciello, J. Im, and R. Ramesh

X-Ray Standing Wave Analysis of Domain Switching in Single Crystal Lead Zirconium Titanate (PZT) Thin Films

M.J. Bedzyk, O. Auciello, C. Thompson, S.K. Streiffer, B.G. Stephenson, J.A. Eastman, G.R. Bai, D.A. Marasco, A. Kazimirov, T-L. Lee, and C.B. Eom

In situ Studies of the Surface Structure of Strontium-Bismuth-Tantalate Films Using Time-of-Flight Ion Scattering and Recoil Spectroscopy

J. Im, O. Auciello, A.R. Krauss, J. Lettieri, and D.G. Schlom

NOVEL CHARACTERIZATION - II

Electric Force Microscopy of Ferroelectric Thin Films

C. Ahn

Scaling of Ferroelectric Properties in Thin Films

C. Ganpule, A. Staneshevsky, Q. Su, S. Aggarwal, J. Melngailis, E. Williams, and R. Ramesh

SFM Characterization of $\text{SrBi}_2\text{Ta}_2\text{O}_9$ Thin Films for Nanoscale Memory Applications

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Imprint, Retention and Polarization Back-Switching Effects in Virgin and Fatigued Pt-PZT-Pt Systems Studied by Atomic Force Microscopy

E.L. Colla and A. Raake

Polarization Relaxation in Sub-Micron Ferroelectric Thin Films

R. Ramesh, C. Ganpule, V. Nagarajan, A. Stanishevsky, Q. Su, A. Aggarwal, J. Melngailis, and E. Williams

The Ferroelectric / Electrode Interface

A. Hartmann

Theory of Ferroelectric Thin Films

Y. Ishibashi and H. Orihara

How to Learn the Domain Kinetics from the Switching Current Data

V.Y. Shur, E.L. Rumyantsev, S.A. Makarov, V.L. Kozhevnikov, E.V. Nikolaeva, and E.I. Shishkin

Piezoelectric Analysis of $\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$ and $\text{Sr}_{0.8}\text{Bi}_{1.3}\text{Ta}_2\text{O}_9$ Thin Films Using Atomic Force Microscopy

J.A. Christman, H. Maiwa, S-H. Kim, J-P. Maria, R.J. Nemanich, and A.I. Kingon

180° Domain Stability Measurements in Ferroelectric Thin Films

J.E. Blendell, J.L. Hertz, and G.S. White

PIEZOELECTRIC AND MEMS APPLICATIONS

Hydrothermal Method PZT Film and its Application to Actuators and

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Sensors

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PIEZOELECTRICITY AND PYROELECTRICITY DATABASE (PPDB)

The database used in Professor Sidney B. Lang's "**Guide to the Literature of Piezoelectricity and Pyroelectricity**" which appears semiannually in *Ferroelectrics* is now accessible on the Gordon and Breach Internet Website.

The current version of the Piezoelectricity and Pyroelectricity Database (PPDB) contains references to most of the publications on piezoelectricity and pyroelectricity during the period 1990-1996. The database will be updated with an additional 500-1000 new references about twice a year. In order to make the database as comprehensive as possible, references are included even if piezoelectricity and/or pyroelectricity formed a very minor part of the contents of the publication. The current database contains 10722 references.

References are given for articles in journals, chapters in proceedings or books, books, patents, theses and reports. Full bibliographic information is given so that the reader can locate the publication. Additional information such as conference presentation data, language (if other than English) and patent assignees is given where available.

The URL for accessing PPDB is http://www.gbhap-us.com/c3/lit_guide/

Information in the PPDB can be accessed in two ways: (1) Direct search of the database on the Internet or (2) Downloading of the entire database and a public-domain search engine to the user's computer. Full instructions are supplied.

Any problems with the PPDB or suggestions should be sent to:

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of *Ferroelectrics* contain the proceedings of

The Sixth Japanese – CIS/Baltic Symposium on Ferroelectricity

held in Noda, Japan
22 - 25 March 1998

VERSAILLES PROJECT

VERSAILLES PROJECT ON ADVANCED MATERIALS AND STANDARDS

Mark Gee and Markys G. Cain of the National Physical Laboratory in Teddington, UK, are initiating a project to evaluate measurement methods for determining the performance related properties of electroceramics. They are planning to enlist the cooperation of measurement laboratories interested in this project.

Electroceramics, such as piezoelectric and electrostrictive materials, have the capability of converting electrical energy into mechanical energy (or vice versa). The technological importance of these materials is increasing, with widespread applications in actuator and sensor applications.

Although there has been some standardization activity through bodies such as the IEEE, and more recently through CENELEC in the development of new standards, many of the most important properties that are required for these materials when used as sensors and actuators remain without internationally recognized test methods.

Measurements where work is required include:

- direct and converse piezoelectric coefficient measurement
- high stress dielectric property measurement
- the measurement of strain at high stresses, and
- the measurement of degradation of materials performance under repeated electrical and mechanical loading.

Industries that would benefit from these activities are the manufacturers of materials, sensors, actuators, and any industries that incorporate devices based on these materials.

Although further practical measurement-based projects would be expected to follow, the subject of these

projects cannot be fully predicted in advance of the results of the survey. However, it is expected that work would be carried out at least on the development of recommended procedures for the following four projects:

1. Measurement of piezoelectric coefficient of materials of differing geometries and configurations, including the assessment of direct and converse coefficients
2. Measurement of piezoelectric strain at high electrical/mechanical stress
3. Measurement of piezoelectric and dielectric properties at high stress
4. Measurement of electrical and mechanical fatigue of piezoelectric ceramics materials.

Appropriate links would be developed with the convenor of the CENELEC committee (Alan Thomas) so that the route forward to the development of standards from the prestandardization work performed in the Technical Work Area is straightforward.

It is expected that the development of standard methods would proceed from Autumn 1999 with an estimated lifetime of 2-3 years.

Please direct any inquiries to:

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A collection of papers from the
Second Workshop on Nonlinear Models of Biomembrane Molecular Structures
held in Pushchino, Russia, 26 June - 1 July 1995
&
The Workshop on Condensed-state Models of Voltage-dependent Ion Channels
Kansas City, Missouri, USA, 25 February 1998

MRS PUBLICATIONS**NEW RELEASES FROM THE MATERIALS RESEARCH SOCIETY****MRS Expands Series on Thin Films—Stresses and Mechanical Properties**

The newest volume is a continuing series from the Materials Research Society, *Thin Films—Stresses and Mechanical Properties VII*, documents symposium reports from the 1997 MRS Fall Meeting in Boston, Massachusetts, and contains 95 papers, 646 pages.

Mechanical behavior in thin films continues to be a growing field of interest in the materials research community. This behavior can critically influence the design, performance, and reliability of thin-film structures used in every area of thin-film technology. Examples of affected areas include semiconductor and magnetic recording technology, as well as protective and hard-coating technology. As a result, it has become important to study and attempt to understand fundamental issues involved in film-substrate adhesion, the development of intrinsic stresses, and the mechanisms of plastic deformation, strain relaxation, and fracture in thin films.

This volume, the seventh in a popular series from the MRS, brings together an international group of researchers and students from industry, academia, and national laboratories to address the issues at hand. A great deal of work is directed toward improving existing, as well as developing new, mechanical property characterization techniques, such as more sensitive ultrasonic methods for elastic behavior determination and low-load indentation methods to investigate yield, creep, and fracture behavior. Experimental, theoretical, and modeling work is presented. Topics include: novel testing methods; low-load indentation; metallization and reliability; structural and mechanical stability; stresses and mechanical behavior; surface and tribological properties; adhesion; deformation mechanisms; stresses in thin films—generation mechanisms and measurement techniques; modeling and simulation; multilayered and superlattice thin films; and structure/property/processing relationships.

Edited by Robert C. Cammarata (Naval Research Laboratory), Michael A. Nastasi (Los Alamos National Laboratory), Esteban P. Busso (Imperial College, University of London), and Warren C. Oliver (Nano Instruments, Inc.), *Thin Films—Stresses and Mechanical Properties VII* (ISBN: 1-55899-410-6) is Volume 505 in the MRS

Symposium Proceedings Series. It is available in hardcover or microfiche for \$62.00 (MRS members), \$71.00 (US list), and \$82.00 (Non-US list).

MRS Introduces New Addition to Series on Low-Dielectric Constant Materials

The latest edition in the continuing series from the Materials Research Society, *Low-Dielectric Constant Materials IV*, documents symposium reports from the 1998 MRS Spring Meeting in San Francisco, California, and contains 49 papers, 386 pages.

While this volume continues the series of materials science related to the development of low-dielectric (low-k) constant materials, it particularly focuses on four major areas: polymeric and inorganic low-k dielectrics; metrology and characterization; process integration and low-k interconnects; and reliability of low-k interconnects. These are important issues for development of low-k dielectrics for ULSI interconnects, where materials and processing play an important role in controlling the structural integrity and reliability of the interconnect. The volume is strengthened by invited and contributed papers from both universities and industry, illustrating the cross-disciplinary nature of the field.

Edited by Chien Chiang (Intel Corporation), Paul S. Ho (University of Texas—Austin), Toh-Ming Lu (Rensselaer-Polytechnic Institute), and Jeffrey T. Wetzel (Motorola Inc.), *Low-Dielectric Constant Materials IV* (ISBN: 1-55899-417-3) is Volume 511 in the MRS Symposium Proceedings Series. It is available in hardcover or microfiche for \$63.00 (MRS members), \$72.00 (US list), and \$83.00 (Non-US list).

For further information, or to place an order, contact

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PUBLICATIONS**1999 MRS Publications Catalog Supplement Now Available**

The *1999 Materials Research Society (MRS) Publications Catalog Supplement*, containing 72 new books—all exploring interdisciplinary research on advanced materials—is now available. The volumes span many subject areas, including biomedical materials, catalysts, ceramics and composites, computational methods, electronic materials and processing, education, glasses and insulators, materials characterization, metals and alloys, novel processing/applications, nuclear waste management, polymers, sensors, and more.

Also featured in this Supplement is the new *Proceedings of the 12th International Zeolite Conference*. With four volumes and more than 3360 pages, this proceedings is one of the largest collections on zeolite science ever assembled.

To receive a free copy of the 24-page catalog, contact the Material Research Society, Customer Services Department. (For address, phone, and fax, see previous page.)

Ferroelectric Memories Featured in *Physics Today*

Orlando Auciello (Argonne National Laboratory, Argonne, Illinois, USA), **James F. Scott** (University of New South Wales, Sydney, Australia), and **Ramamoorthy Ramesh** (University of Maryland, College Park, Maryland, USA) published an article called “**The Physics of Ferroelectric Memories**” in the July 1998 issue of *Physics Today*.

After discussing basic ferroelectric physics, the authors explain how NVFRAMs work and give an overview of the early developments in the field of ferroelectric memories. Capacitor degradation and extending the polarization retention time were obstacles which could only be overcome by using thin-film technology. But that did not solve all the problems. Today there are still basic physics-related issues we do not completely understand. The authors deal with these challenges, describe the current state of thin-film technology and industrial fabrication, and conclude with an evaluation of the role ferroelectric memories will play in the future. The article includes four figures and features two boxes: “DRAMs based on materials with high permittivity” and “Other applications of ferroelectric materials.”

Ferroelectricity Newsletter

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<http://www.sp.nps.navy.mil/projects/ferro/ferro.html>

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UPCOMING MEETINGS**The 15th Russian Conference on Physics of Ferroelectrics****14 - 18 September 1999****Azov, near Rostov-on-Don, Russia**

Sponsored by the Ministry of General and Professional Education of Russia, the Scientific Committee of Physics of Ferroelectrics of the Russian Academy of Science, Rostov State University, Rostov State Pedagogical University, the Scientific and Research Institute of Physics at Rostov State University, and the Moscow Institute of Radio Engineering, Electronics and Automatics - Technical University, the 15th Russian Conference on Physics of Ferroelectrics, with the participation of foreign scientists, will be held in Azov from 14 - 18 September 1999.

Topics

- Physical properties of ferroelectrics
- Phase transitions and critical phenomena
- Structure and dynamics of crystal lattice
- Relaxor ferroelectrics
- Surface phenomena, nanocrystals, incommensurate phases, etc.
- Domain structure and processes of switching
- Physical properties and processes in ceramics and compound materials

Forms of Presentation

- Plenary presentation (40 minutes)
- Original presentation (15 minutes)
- Poster presentation
- Official languages are Russian and English

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UPCOMING MEETINGS

Piezotechnique 99
14 - 18 September 1999
Azov, near Rostov-on-Don, Russia

This international conference covering scientific and practical aspects of fundamental problems of piezoelectricity and its applications is sponsored by the Ministry of General and Professional Education of Russia, the Russian Space Agency, Rostov State University, the Scientific & Technological Bureau Piezopribor at Rostov State University, as well as the Scientific and Research Institute of Physics at Rostov State University.

Topics

- Theoretical modeling and design of piezoelectric transducers and devices
- Application of materials for piezotechnique devices
- Theoretical and experimental investigations on physics of piezoelectric transducers, on polarization processes, and technological aspects of piezomaterials processing
- Piezoelectric materials science
- Special instruments for investigation and testing of piezomaterials, sensors and piezoelectric transducers
- Detecting and transforming devices, nondestructive testing devices, filters, drives, piezomotors, piezotransformers, ultrasound systems, medical equipment and household appliances
- New directions of piezotechnique (smart materials, hybrid structures, nontraditional piezoelectric systems, nanotechnology, etc.)
- Exhibition of piezoelectric products (materials, technologies, active elements, devices), presentation and sale of scientific and technical materials (monographs, proceedings, advertisement prospects etc.)

Exhibitions and Company Participation

Domestic and foreign piezoelectric companies are welcome to participate. Companies could present a talk as well as exhibit samples of their products.

Proceedings

The presentations will be published before the beginning of the conference as *Conference Proceedings*.

Organizing Committee

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The 15th Russian Conference on Physics of Ferroelectrics is held simultaneously with **Piezotechnique 99**. Participants of Piezotechnique 99 can attend the 15th Russian Conference on Physics and Ferroelectrics without additional fee.

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UPCOMING MEETINGS

**Materials Research Society 1999 Fall Meeting
29 November - 3 December 1999
Boston, Massachusetts, USA**

The Fall 1999 Materials Research Society Meeting will highlight recent and significant advances in the understanding and synthesis of materials. More than 40 technical symposia will cover a wide range of topics in materials science, including self-assembled and nanostructured materials, surfaces and interfaces, thin-film materials and processes, soft materials including biological applications, semiconductor devices, ceramics, structural materials, and materials modeling.

New symposia will be offered in many exciting areas, such as biomineralization, the materials science of food, complex fluids, superplasticity, molecular electronics, and smart materials. Popular ongoing series of symposia will continue in nitride semiconductors, ferroelectric thin films, nanophase and nanocomposite materials, high-temperature superconductors, the materials science of MEMS devices, interfacial engineering and epitaxy, and nuclear waste management. Symposia on computer modeling and calculations in materials science will provide a forum for interaction between theorists and experimentalists. Strong interaction among the symposia will highlight the interdisciplinary nature of materials science.

Tutorial sessions in selected areas will provide introductions to new fields. There will be an exhibition of products and services of interest to the materials community, and the popular Symposium X series will feature topics on the forefront of materials science.

Sample of Symposia

- T: Structure and electronic properties of ultrathin dielectric films on silicon and related structures
- V: Thin Films—Stresses and mechanical properties VIII
- Y: Ferroelectric thin films VIII
- Z: Thin films for optical waveguide devices

Abstracts

For all abstracts submitted by email, fax, or mail, the deadline is **7 June 1999**. Because the most efficient way to submit an abstract is via the MRS Website—the choice of more than 90 percent of submitting authors—the deadline for abstracts submitted **via the Website will be extended until 21 June 1999**.

For specific technical information, contact any of the 1999 Fall Meeting Chairs

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Website

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CALENDAR OF EVENTS 1999

Jun 7-10	• Transducers '99: The 10th International Conference on Solid-State Sensors and Actuators, Sendai, Japan (see <i>Ferroelectricity Newsletter</i> , Vol. 6, No. 3, p.17)
Jun 20-25	• Gordon Research Conference on Thin Films and Crystal Growth Mechanisms, Plymouth State College, Plymouth, New Hampshire, USA Gordon Research Conferences, University of Rhode Island, PO Box 984, West Kingston, RI 02894-0984; phone: +401-783-4011; email: grc@grcmail.grc.uri.edu Website: http://www.grc.uri.edu
Jun 24-26	• 3rd Korea-Japan Conference on Ferroelectrics, Kyungju, Korea (see <i>Ferroelectricity Newsletter</i> , Vol. 6, Nr. 4, p. 35)
Jul 12-16	• 9th European Meeting on Ferroelectricity (EMF-9), Prague, Czech Republic (see <i>Ferroelectricity Newsletter</i> , Vol. 6, No. 3, p. 18)
Jul 31- Aug 1	• Short Course on Crystal Growth, Tucson, Arizona, USA (see <i>Ferroelectricity Newsletter</i> , Vol. 6, No. 3, p. 19)
Aug 1-6	• 11th American Conference on Crystal Growth and Epitaxy, Tucson, Arizona, USA (see <i>Ferroelectricity Newsletter</i> , Vol. 6, No. 3, p. 19)
Aug 4-13	• 18th International Union of Crystallography and General Assembly, Glasgow, Scotland Gill Houston, crystal@glasconf.demon.co.uk or Chris Gilmore iucr99@chem.gla.ac.uk
Aug 29- Sep 3	• 7th International Conference on Ferroelectric Liquid Crystals (FLC 99), Darmstadt, Germany (see <i>Ferroelectricity Newsletter</i> , Vol. 7, No. 1, p. 23)
Sep 14-18	• 15th Russian Conference on Physics of Ferroelectrics, Rostov-on-Don, Russia (see p. 17)
Sep 14-18	• Piezotechnique 99, Rostov-on-Don, Russia (see p. 18)
Sep 30- Oct 2	• European Conference on Macromolecular Physics (EPS'99), Potsdam, Germany (see <i>Ferroelectricity Newsletter</i> , Vol. 7, No. 1, p. 23)
Nov. 29- Dec. 3	• MRS 1999 Fall Meeting, Boston, Massachusetts, USA (see p. 19)